SOLAR/2018-79/03

Monthly Performance Report

REEDY CREEK UTILITIES

MARCH 1979

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

MONTHLY PERFORMANCE REPORT
REEDY CREEK UTILITIES
MARCH 1979

I. SYSTEM DESCRIPTION

The Reedy Creek site is a two story, 5,625 square foot concrete block office building located in Lake Buena Vista, Florida. The solar energy system is designed to provide space heating, domestic hot water and space cooling.

The collector subsystem is composed of a horizontal array of 16 parabolic trough collectors, manufactured by AAI Corporation, with tracking absorber tubes. The collector array is an integral part of the building's roof, with the reflector troughs oriented so that each major axis is in an east-west direction. The 16 absorber tubes are moved in unison in a north-south direction by the solar tracking system. The total collector aperture area is 3,840 square feet. Water is used as the heat collection, transfer, and storage medium. Collected solar energy is stored in a 10,000-gallon hot water tank, located adjacent to the building and shaded by the roof. Domestic hot water is provided by a heat exchanger immersed in this tank. Space heating is provided by circulation of hot water from the storage tank through heat exchangers located in the central air distribution system. No auxiliary energy is provided for either domestic hot water or space heating.

A 25-ton absorption chiller utilizes hot water from solar storage to provide chilled water to a 10,000-gallon cold water storage tank. For space cooling, water from this cold tank is circulated through heat exchangers located in the building's central air distribution system. Auxiliary cooling is provided by supplemental cold water from the utility district's central chiller plant, which is powered by fossil fuels.

The system, shown schematically in Figure 1, has five modes of solar operation.

Mode 1 - Collector-to-Storage: This mode is entered when the collector absorber plate temperature is 10°F higher than the temperature at the bottom of the hot storage tank (water solar thermal storage). Water is circulated through the collector array-storage loop by pump P1 until the temperature of the water at the bottom of storage rises to within 3°F of that of the collector absorber plate.

Mode 2 - Storage-to-Space Heating: This mode is entered when the temperature falls below the setting of the thermostats located in the occupied areas. Since this is the only means of space heating available, no minimum tank temperature is specified. Pump P2 causes hot water to flow directly from the storage tank to the heat exchanger in the air-handling unit, and back to the storage tank.

Mode 3 - Domestic Hot Water Heating: Domestic hot water (DHW) is provided by passing city supply water through a heat exchanger immersed in the solar thermal storage tank. No conventional water heater exists, thus water is heated only upon demand. A tempering valve is used when necessary to reduce the temperature of water leaving the heat exchanger. If the water is too hot, cold supply water is mixed with it in the tempering valve before going to the domestic hot water line.

Mode 4 - Chilled Water Production: This mode is entered when the temperature of the water in the top of the solar thermal storage tank is at or above the generator operating temperature (nominally 180°F) and that of the water at the bottom of the 10,000-gallon chilled water storage is greater than 45°F. Hot water is drawn from the solar thermal storage tank to operate the generator section of the absorption chiller and cold water is circulated through the chiller from the chilled water storage. Energy is removed from the cold water, lowering its temperature; the energy is rejected though the cooling tower, and the cold water returns to the chilled water storage tank. Whenever the temperature

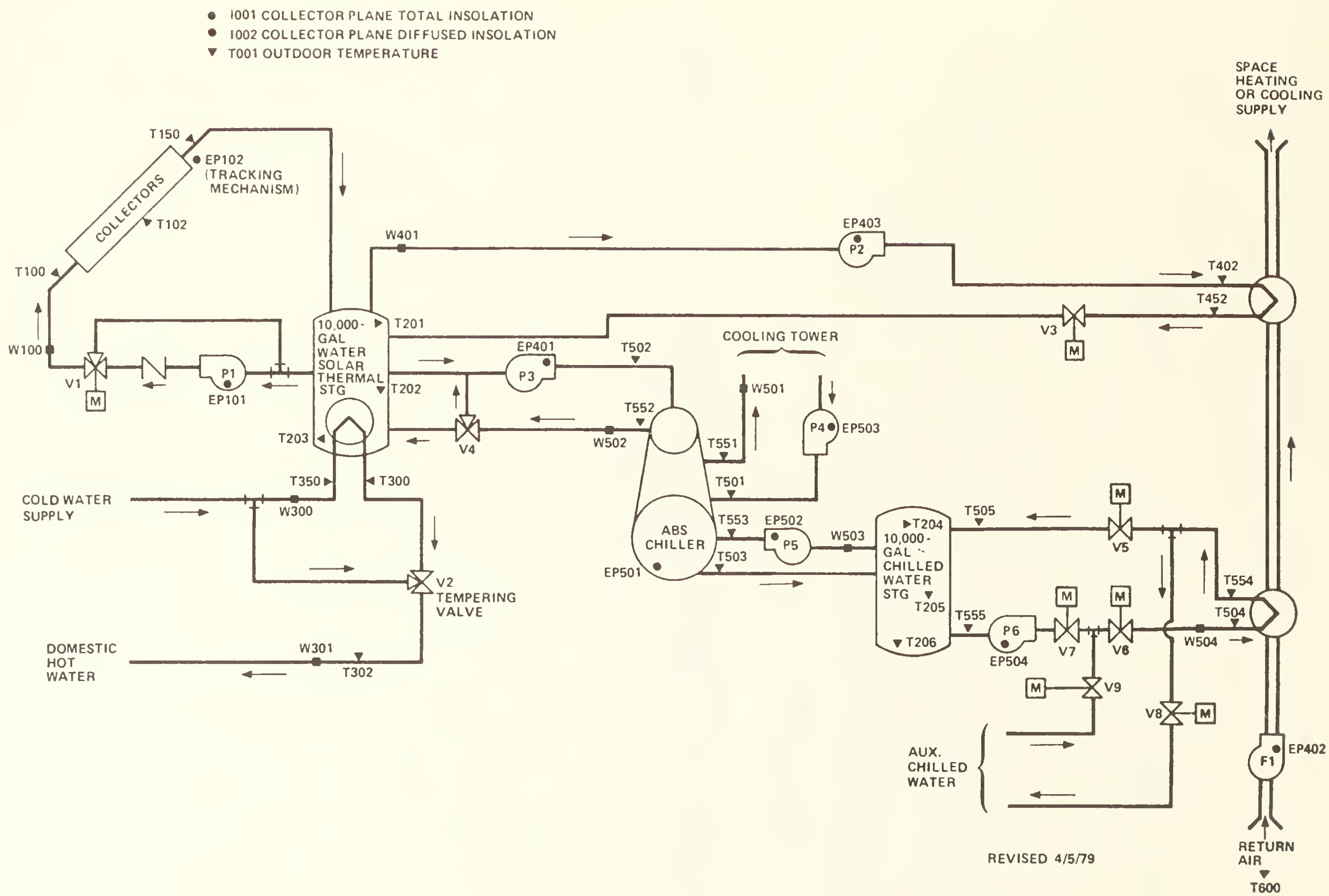

Figure 1. REEDY CREEK SOLAR ENERGY SYSTEM SCHEMATIC

of the water going to the generator exceeds the upper limit of 195°F, the water is tempered with cooler water returning through valve V4.

<u>Mode 5 - Space Cooling</u>: The space cooling mode is initiated when the building temperature exceeds the setting of the conditioned space thermostat. Chilled water from the chilled water storage is then circulated by pump P6 to the heat exchangers in the building air distribution system. If the chilled water storage system is not able to meet the cooling load, an auxiliary chilled water supply is available from the central energy plant.

II. PERFORMANCE EVALUATION

A. Introduction

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data.

The Reedy Creek solar energy system operated continuously throughout the month of March. The domestic hot water demand was 0.17 million Btu; the space heating demand was 5.59 million Btu; the space cooling demand was 6.17 million Btu. The solar energy system supplied 100 percent of the domestic hot water and space heating requirements, and 98 percent of the space cooling requirements - these quantities are reported in the attached computer printout as loads.

B. Weather

For March, the average outside ambient temperature measured at the site was 66°F. The long-term average temperature is 65.9°F at the Orlando weather station. The average measured insolation in the plane of the array was only 1,501 Btu/ft^2-day. This is considerably less than the long-term average of 1,746 Btu/ft^2-day for March, which was derived from measurements taken at the Tampa weather station.

C. System Thermal Performance

Collector - Of the 178.7 million Btu incident on the collector array, 29.6 million Btu were collected and delivered to the solar thermal storage tank. This represents an array efficiency of 16.6 percent. Operating energy of 1.6 million Btu (463 kwh) was required to collect and store this solar energy.

Storage - Of the 29.6 million Btu delivered to storage, 19.4 million Btu were subsequently removed for use within the system. Temperature probes within the solar thermal storage tank indicate that the internal energy of the water increased by 1.7 million Btu during the month. This indicates a resulting loss to the environment of 8.5 million Btu through the tank insulation. A further discussion of the tank insulation heat transfer is contained in Section II-D, Observations.

Domestic Hot Water - Domestic hot water is provided to the building by passing city water through a heat exchanger that is immersed in the solar thermal storage tank. A total of 370 gallons of water at an average temperature of 130°F were supplied by this system during March. The average temperature increase was 60°F, which resulted in a measured demand of 0.17 million Btu. All of this energy was supplied by the solar energy system. There was no operating energy required.

Space Heating - Space heating was required during a portion of 18 different days during March. Hot water was pumped from the solar thermal storage tank to a heat exchanger coil in the air ducts to satisfy this requirement. An operating energy expenditure of 0.8 million Btu (229 kwh) was required to satisfy the 5.6 million Btu demand.

Absorption Chiller - The absorption chiller operated on nine occasions to reduce the chilled water storage temperature during March. Use of 0.11 million Btu from the auxiliary conventional cooling system was required to assist the absorption chiller to meet the cooling load on one day of the month. The absorption chiller utilized 13.67 million Btu from the

solar thermal storage tank to remove 7.41 million Btu from the chilled water storage (see attached Auxiliary Performance data). The resulting coefficient of performance of 0.542 compares favorably with the average C.O.P. value of 0.52 observed in this system during the previous five months of operation.

Chilled Water Storage - Performance of the chilled water storage (see attached Auxiliary Storage Performance data) shows that 7.41 million Btu were removed by the chiller, 6.01 million Btu were added from the conditioned space during cooling, and the internal energy of the chilled water storage decreased by 1.45 million Btu. This implies that 0.03 million Btu were lost through the insulation to the environment. Note that the second and third columns of the Auxiliary Storage Performance Table have been changed. The second column, "Energy To Storage", represents the thermal energy removed from the air and put into the chilled water storage tank. The third column, "Energy From Storage", represents the thermal energy removed from the chilled water storage tank by the absorption chiller. In reports prior to February, the values in these columns were reversed. A further discussion of the tank insulation heat transfer is contained in Section II-D, Observations.

Space Cooling - Space cooling was required on all but two of the working days of the month. The space cooling load was 6.17 million Btu. Water from the chilled water storage was pumped through the air duct heat exchangers to remove 6.01 million Btu. Chilled water from the central plant was required to assist in supporting the cooling load during one day of the month - March 5. This resulted from the previous use of the chilled water storage for space cooling, which had raised the storage temperature to a level near the room temperature. Meanwhile, insufficient insolation had prevented use of the absorption chiller.

D. Observations

Previous monthly reports had contained estimates of the insulation performance for the solar thermal and chilled water storage tanks. This

estimate was based on the indicated energy transfer between the tanks and the ambient environment, the monthly average tank and ambient temperatures, and the surface areas of the tanks. However, this estimate has proven not to be accurate when calculated using the monthly averages, particularly when a tank temperature is near the ambient temperature. The transfer of energy through the insulation is an hourly and daily phenomenon and may actually reverse directions during a month duration; the monthly averages do not reflect this information. Additionally, during a period such as this month, when a tank temperature is near ambient, the 0.25° accuracy of the temperature sensors may not be sufficient to quantify the actual temperature differences. These sensors were not intended to be used for this purpose, and the estimate of the insulation performance will be made only when there is sufficient temperature difference to make the sensor errors a small function of the total measurement.

Several of the values in the Storage Performance Table for March may be misleading without additional explanation. As mentioned previously, it is very difficult to make precise energy measurements of the exact amount of energy contained in a large storage tank with three sensors. The occurrence of thermal stratification can become misleading in calculating the average or total energy, and therefore, the value calculated for the change in stored energy may become questionable if the flow into and out of the tank is small. Therefore, the values shown for storage efficiency in the Storage Performance Table may become questionable as the values measured for energy into, energy from, or change in energy of the storage system become quite small (approximately 0.2 million Btu or less).

Near the end of February, all sensors at Reedy Creek were recalibrated to maintain maximum accuracy. Following that recalibration, the temperature sensor for the water exiting the generator of the absorption chiller appears to be indicating a temperature approximately 1.4°F high. Temporary modifications have been incorporated into the performance analysis software to compensate for this, as it is being investigated.

E. Energy Savings

Total system electrical energy savings of 0.9 million Btu (265 kwh) were realized. This value assumes that, had there not been a solar energy system, the energy requirements would have been met by an electrical hot water heater and by a conventional electrical heat pump.

III. ACTION STATUS

The discrepancy of the temperature sensor at the generator exit of the absorption chiller is being investigated.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: REEDY CREEK
REPORT PERIOD: MARCH,1979

SOLAR/2018-79/03

SITE/SYSTEM DESCRIPTION:
THE REEDY CREEK SITE IS A 5625 SQ. FT. CONCRETE BLOCK OFFICE BUILDING. THE LIQUID SYSTEM EMPLOYS 3840 SQ. FT. OF PARABOLIC TROUGH COLLECTORS WHICH FORM AN INTEGRAL PART OF THE ROOF. THE SYSTEM IS DESIGNED TO PROVIDE SPACE HEATING, COOLING, AND DOMESTIC HOT WATER. STORAGE CONSISTS OF 10,000 GALLONS OF BOTH HOT AND COLD WATER. AN ABSORPTION CYCLE CHILLER PROVIDES COOLING, A RADIANT HOT WATER COIL PROVIDES HEATING AND A COIL SUBMERGED IN THE HOT STORAGE TANK PROVIDES HOT WATER. AUXILIARY COOLING IS PROVIDED BY CHILLED WATER FROM THE CENTRAL COOLING PLANT. THERE IS NO AUXILIARY DHW OR HEATING.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	178.732 MILLION BTU
	46545 BTU/SQ.FT.
COLLECTED SOLAR ENERGY	29.612 MILLION BTU
	7712 BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	66 DEGREES F
AVERAGE BUILDING TEMPERATURE	69 DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.11
ECSS OPERATING ENERGY	1.583 MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	5.995 MILLION BTU
TOTAL ENERGY CONSUMED	35.651 MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.170	5.593	6.173	11.935 MILLION BTU
SOLAR FRACTION	100	100	98	99 PERCENT
SOLAR ENERGY USED	0.170	5.593	13.674	19.436 MILLION BTU
OPERATING ENERGY	N.A.	0.781	3.630	5.995 MILLION BTU
AUX. THERMAL ENERGY	N.A.	N.A.	0.110	0.110 MILLION BTU
AUX. ELECTRIC FUEL	N.A.	N.A.	0.044	0.044 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	0.170	2.132	0.186	0.904 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.594

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: REEDY CREEK
REPORT PERIOD: MARCH,1979

SOLAR/2018-79/03

SITE/SYSTEM DESCRIPTION:

THE REEDY CREEK SITE IS A 5625 SQ. FT. CONCRETE BLOCK OFFICE BUILDING. THE LIQUID SYSTEM EMPLOYS 3840 SQ. FT. OF PARABOLIC TROUGH COLLECTORS WHICH FORM AN INTEGRAL PART OF THE ROOF. THE SYSTEM IS DESIGNED TO PROVIDE SPACE HEATING, COOLING, AND DOMESTIC HOT WATER. STORAGE CONSISTS OF 10,000 GALLONS OF BOTH HOT AND COLD WATER. AN ABSORPTION CYCLE CHILLER PROVIDES COOLING, A RADIANT HOT WATER COIL PROVIDES HEATING AND A COIL SUBMERGED IN THE HOT STORAGE TANK PROVIDES HOT WATER. AUXILIARY COOLING IS PROVIDED BY CHILLED WATER FROM THE CENTRAL COOLING PLANT. THERE IS NO AUXILIARY DHW OR HEATING.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	188.562 GIGA JOULES
	528563 KJ/SQ.M.
COLLECTED SOLAR ENERGY	31.241 GIGA JOULES
	87573 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	19 DEGREES C
AVERAGE BUILDING TEMPERATURE	21 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.11
ECSS OPERATING ENERGY	1.671 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	6.325 GIGA JOULES
TOTAL ENERGY CONSUMED	37.612 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.179	5.900	6.513	12.592 GIGA JOULES
SOLAR FRACTION	100	100	98	99 PERCENT
SOLAR ENERGY USED	0.179	5.900	14.426	20.505 GIGA JOULES
OPERATING ENERGY	N.A.	0.824	3.830	6.325 GIGA JOULES
AUX. THERMAL ENG	N.A.	N.A.	0.116	0.116 GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	N.A.	0.046	0.046 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	0.179	2.249	0.197	0.954 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.594

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@ DENOTES NULL DATA
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REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: REEDY CREEK
REPORT PERIOD: MARCH,1979

SOLAR/2018-79/03

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	*	*	*	N	*	N	*
2	5.241	72	0.187	O	0.032	O	0.036
3	4.610	71	0.001	T	0.037	T	0.000
4	3.568	71	0.001		0.017		0.000
5	3.347	71	0.011	A	0.017	A	0.003
6	0.475	60	0.301	P	0.000	P	0.634
7	6.816	59	0.424	P	0.075	P	0.062
8	3.908	60	0.548	L	0.021	L	0.140
9	6.927	62	0.367	I	0.077	I	0.053
10	7.016	65	1.793	C	0.075	C	0.256
11	3.328	56	0.000	A	0.013	A	0.000
12	6.926	59	0.524	B	0.071	B	0.076
13	5.927	66	0.328	L	0.050	L	0.055
14	5.860	70	1.450	E	0.057	E	0.247
15	7.513	63	0.271		0.075		0.036
16	5.563	65	1.366		0.036		0.246
17	4.406	67	0.000		0.033		0.000
18	6.877	67	0.000		0.061		0.000
19	7.175	69	2.070		0.075		0.288
20	6.877	70	0.229		0.073		0.033
21	7.170	71	2.068		0.075		0.288
22	5.382	71	0.011		0.035		0.002
23	1.157	69	0.006		0.000		0.005
24	7.118	70	0.000		0.071		0.000
25	6.664	62	1.499		0.061		0.225
26	7.864	57	0.562		0.078		0.071
27	7.820	64	1.935		0.076		0.247
28	7.547	69	1.224		0.075		0.162
29	6.174	70	0.166		0.052		0.027
30	7.143	73	1.465		0.065		0.205
31	6.569	73	0.000		0.051		0.000
SUM	178.732	-	19.436	N.A.	1.583	N.A.	-
AVG	5.766	66	0.627	N.A.	0.051	N.A.	0.109
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: REEDY CREEK
REPORT PERIOD: MARCH,1979

SOLAR/2018-79/03

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	*	*	*	*	*
2	5.241	2.303	0.322	80	0.062
3	4.610	2.465	0.398	80	0.086
4	3.568	0.877	-0.062	81	-0.017
5	3.347	1.310	0.120	78	0.036
6	0.475	0.000	0.000	58	0.000
7	6.816	6.244	1.606	69	0.236
8	3.908	1.459	0.378	68	0.097
9	6.927	6.421	1.617	73	0.233
10	7.016	6.240	1.607	77	0.229
11	3.328	0.994	0.074	59	0.022
12	6.926	6.042	1.450	69	0.209
13	5.927	4.327	0.755	78	0.127
14	5.860	4.550	0.970	81	0.166
15	7.513	6.672	1.618	71	0.215
16	5.563	3.359	0.579	75	0.104
17	4.406	2.704	0.435	74	0.099
18	6.877	5.502	1.086	78	0.158
19	7.175	6.465	1.545	80	0.215
20	6.877	5.995	1.385	82	0.201
21	7.170	6.393	1.635	84	0.228
22	5.382	2.763	0.447	82	0.083
23	1.157	0.000	0.000	71	0.000
24	7.118	6.156	1.484	76	0.208
25	6.664	5.360	1.141	70	0.171
26	7.864	7.043	1.775	67	0.226
27	7.820	6.818	1.765	76	0.226
28	7.547	6.582	1.518	80	0.201
29	6.174	4.388	0.891	79	0.144
30	7.143	5.905	1.354	83	0.190
31	6.569	4.503	0.765	82	0.117
SUM	178.732	134.167	29.612	-	-
AVG	5.766	4.328	0.955	75	0.166
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: REEDY CREEK SOLAR/2018-79/03
REPORT PERIOD: MARCH,1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	*	*	*	*	*
2	0.322	0.187	0.190	145	1.170
3	0.398	0.001	0.232	146	0.585
4	-0.062	0.001	-0.126	147	2.019
5	0.120	0.011	-0.084	146	-0.609
6	0.000	0.301	-0.527	142	1.000
7	1.606	0.424	1.285	146	1.065
8	0.378	0.548	-0.273	152	0.727
9	1.617	0.367	1.102	157	0.908
10	1.607	1.793	-0.744	163	0.653
11	0.074	0.000	-0.210	155	-2.845
12	1.450	0.524	0.839	158	0.940
13	0.755	0.328	0.335	166	0.878
14	0.970	1.450	-0.911	164	0.555
15	1.618	0.271	1.078	163	0.834
16	0.579	1.366	-1.057	165	0.533
17	0.435	0.000	0.147	157	0.337
18	1.086	0.000	0.764	164	0.704
19	1.545	2.070	-0.901	165	0.757
20	1.385	0.229	0.911	162	0.823
21	1.635	2.068	-0.911	165	0.708
22	0.447	0.011	0.094	158	0.236
23	0.000	0.006	-0.262	156	1.000
24	1.484	0.000	1.194	163	0.805
25	1.141	1.499	-1.037	165	0.406
26	1.775	0.562	1.068	163	0.918
27	1.765	1.935	-0.785	169	0.652
28	1.518	1.224	-0.283	162	0.620
29	0.891	0.166	0.503	160	0.751
30	1.354	1.465	-0.566	162	0.664
31	0.765	0.000	0.587	160	0.767
SUM	29.612	19.436	1.705	-	-
AVG	0.955	0.627	0.055	158	0.714
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: REEDY CREEK
REPORT PERIOD: MARCH, 1979

SOLAR/2018-79/03

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR. OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	*	*	*	N	N	N	N	*	N	*	*	*
2	0.004	100	0.004	O	O	O	O	0.004	O	70	107	8
3	0.001	100	0.001	T	T	T	T	0.001	T	70	127	2
4	0.001	100	0.001					0.001		70	124	2
5	0.007	100	0.007	A	A	A	A	0.007	A	70	124	18
6	0.004	100	0.004	P	P	P	P	0.004	P	70	114	13
7	0.006	100	0.006	P	P	P	P	0.006	P	70	114	17
8	0.007	100	0.007	L	L	L	L	0.007	L	70	122	17
9	0.008	100	0.008	I	I	I	I	0.008	I	70	127	17
10	0.000	0	0.000	C	C	C	C	0.000	C	70	136	0
11	0.000	0	0.000	A	A	A	A	0.000	A	70	136	0
12	0.004	100	0.004	B	B	B	B	0.004	B	70	133	10
13	0.013	100	0.013	L	L	L	L	0.013	L	70	137	26
14	0.007	100	0.007	E	E	E	E	0.007	E	70	132	14
15	0.009	100	0.009					0.009		70	129	19
16	0.006	100	0.006					0.006		70	135	13
17	0.000	0	0.000					0.000		70	137	0
18	0.000	0	0.000					0.000		70	137	0
19	0.010	100	0.010					0.010		70	136	19
20	0.007	100	0.007					0.007		70	133	17
21	0.010	100	0.010					0.010		70	137	18
22	0.011	100	0.011					0.011		70	135	21
23	0.006	100	0.006					0.006		70	135	12
24	0.000	0	0.000					0.000		70	125	0
25	0.000	0	0.000					0.000		70	125	0
26	0.015	100	0.015					0.015		70	128	34
27	0.007	100	0.007					0.007		70	129	15
28	0.004	100	0.004					0.004		70	136	9
29	0.008	100	0.008					0.008		70	129	17
30	0.010	100	0.010					0.010		70	132	20
31	0.000	0	0.000					0.000		70	143	0
SUM	0.170	-	0.170	N.A.	N.A.	N.A.	N.A.	0.170	N.A.	-	-	370
AVG	0.005	100	0.005	N.A.	N.A.	N.A.	N.A.	0.005	N.A.	70	130	12
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: REEDY CREEK
REPORT PERIOD: MARCH, 1979

SOLAR/2018-79/03

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	*	*	*	*	N	N	N	*	N	*	*
2	0.184	100	0.184	0.037	O	O	O	0.068	O	75	72
3	0.000	0	0.000	0.000	T	T	T	0.000	T	71	71
4	0.000	0	0.000	0.000				0.000		73	71
5	0.004	100	0.004	0.003	A	A	A	0.001	A	73	71
6	0.297	100	0.297	0.045	P	P	P	0.113	P	67	60
7	0.418	100	0.418	0.067	P	P	P	0.159	P	67	59
8	0.541	100	0.541	0.072	L	L	L	0.205	L	67	60
9	0.359	100	0.359	0.051	I	I	I	0.137	I	67	62
10	0.000	0	0.000	0.000	C	C	C	0.000	C	65	65
11	0.000	0	0.000	0.000	A	A	A	0.000	A	60	56
12	0.520	100	0.520	0.072	B	B	B	0.203	B	66	59
13	0.315	100	0.315	0.040	L	L	L	0.119	L	69	66
14	0.216	100	0.216	0.026	E	E	E	0.082	E	71	70
15	0.261	100	0.261	0.034				0.099		69	63
16	0.295	100	0.295	0.041				0.111		68	65
17	0.000	0	0.000	0.000				0.000		68	67
18	0.000	0	0.000	0.000				0.000		67	67
19	0.392	100	0.392	0.049				0.150		70	69
20	0.222	100	0.222	0.036				0.083		70	70
21	0.117	100	0.117	0.014				0.045		71	71
22	0.000	0	0.000	0.000				0.000		72	71
23	0.000	0	0.000	0.000				0.000		73	69
24	0.000	0	0.000	0.000				0.000		71	70
25	0.000	0	0.000	0.000				0.000		64	62
26	0.548	100	0.548	0.072				0.213		66	57
27	0.356	100	0.356	0.043				0.138		67	64
28	0.209	100	0.209	0.029				0.079		69	69
29	0.158	100	0.158	0.025				0.059		71	70
30	0.000	0	0.000	0.000				0.000		73	73
31	0.000	0	0.000	0.000				0.000		73	73
SUM	5.593	-	5.593	0.781	N.A.	N.A.	N.A.	2.132	N.A.	-	-
AVG	0.180	100	0.180	0.025	N.A.	N.A.	N.A.	0.069	N.A.	69	66
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE COOLING SUBSYSTEM

SITE: REEDY CREEK
REPORT PERIOD: MARCH,1979

SOLAR/2018-79/03

DAY OF MON.	SPACE COOLING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG DRY BULB TEMP F	AMB TEMP DEG F
1	*	*	*	*	*	*	N	*	N	*	*
2	0.273	100	0.000	0.193	0.000	0.000	O	0.070	O	75	72
3	0.000	0	0.000	0.000	0.000	0.000	T	0.000	T	71	71
4	0.000	0	0.000	0.000	0.000	0.000		0.000		73	71
5	0.261	59	0.000	0.083	0.106	0.042	A	0.046	A	73	71
6	0.015	100	0.000	0.121	0.000	0.000	P	-0.025	P	67	60
7	0.162	100	0.000	0.090	0.000	0.000	P	0.047	P	67	59
8	0.122	100	0.000	0.083	0.000	0.000	L	0.031	L	67	60
9	0.188	100	0.000	0.092	0.000	0.000	I	0.058	I	67	62
10	0.000	0	1.793	0.171	0.000	0.000	C	-0.171	C	65	65
11	0.000	0	0.000	0.000	0.000	0.000	A	0.000	A	60	56
12	0.168	100	0.000	0.039	0.000	0.000	B	0.060	B	66	59
13	0.532	100	0.000	0.127	0.000	0.000	L	0.189	L	69	66
14	0.553	100	1.227	0.270	0.000	0.000	E	0.054	E	71	70
15	0.368	100	0.000	0.084	0.000	0.000		0.131		69	63
16	0.462	100	1.066	0.247	0.000	0.000		0.031		68	65
17	0.000	0	0.000	0.000	0.000	0.000		0.000		68	67
18	0.000	0	0.000	0.000	0.000	0.000		0.000		67	67
19	0.522	100	1.668	0.313	0.000	0.000		-0.025		70	69
20	0.228	100	0.000	0.050	0.000	0.000		0.072		70	70
21	0.575	100	1.942	0.310	0.000	0.000		-0.001		71	71
22	0.301	100	0.000	0.066	0.000	0.000		0.095		72	71
23	0.234	100	0.000	0.075	0.000	0.000		0.073		73	69
24	0.000	0	0.000	0.000	0.000	0.000		0.000		71	70
25	0.000	0	1.499	0.195	0.000	0.000		-0.195		64	62
26	0.013	100	0.000	0.012	0.000	0.000		-0.006		66	57
27	0.000	0	1.571	0.291	0.000	0.000		-0.291		67	64
28	0.000	0	1.011	0.242	0.000	0.000		-0.242		69	69
29	0.103	100	0.000	0.040	0.000	0.000		0.017		71	70
30	0.894	100	1.455	0.319	0.000	0.000		0.161		73	73
31	0.000	0	0.000	0.000	0.000	0.000		0.000		73	73
SUM	6.173	-	13.674	3.630	0.110	0.044	N.A.	0.186	N.A.	-	-
AVG	0.199	98	0.441	0.117	0.003	0.001	N.A.	0.006	N.A.	69	66
NBS	Q502	N500	Q500	Q503	Q501		Q508	Q512	Q514	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: REEDY CREEK
REPORT PERIOD: MARCH,1979

SOLAR/2018-79/03

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	*	*	*	*	N	N	N
2	1365	757	72	80	O	O	O
3	1201	651	71	80	T	T	T
4	929	632	71	81			
5	872	575	71	78	A	A	A
6	124	102	60	58	P	P	P
7	1775	364	59	69	P	P	P
8	1018	546	60	68	L	L	L
9	1804	280	62	73	I	I	I
10	1827	84	65	77	C	C	C
11	867	560	56	59	A	A	A
12	1804	216	59	69	B	B	B
13	1544	308	66	78	L	L	L
14	1526	388	70	81	E	E	E
15	1957	92	63	71			
16	1449	499	65	75			
17	1147	437	67	74			
18	1791	395	67	78			
19	1869	146	69	80			
20	1791	229	70	82			
21	1867	129	71	84			
22	1402	641	71	82			
23	301	239	69	71			
24	1854	325	70	76			
25	1735	502	62	70			
26	2048	318	57	67			
27	2036	106	64	76			
28	1965	229	69	80			
29	1608	436	70	79			
30	1860	337	73	83			
31	1711	543	73	82			
SUM	46545	11434	-	-	-	-	-
AVG	1501	369	66	75	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
THERMODYNAMIC CONVERSION EQUIPMENT

SITE: REEDY CREEK
REPORT PERIOD: MARCH, 1979

SOLAR/2018-79/03

DAY OF MONTH	EQUIPMENT LOAD MILLION BTU	THERMAL ENERGY INPUT MILLION BTU	OPERATING ENERGY MILLION BTU	ENERGY REJECTED MILLION BTU	COEFFICIENT OF PERFORMANCE (SEE NOTE)
1	*	*	*	*	*
2	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000
10	1.062	1.793	0.171	2.989	0.592
11	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000
14	0.676	1.227	0.138	2.011	0.551
15	0.000	0.000	0.000	0.000	0.000
16	0.624	1.066	0.123	1.773	0.585
17	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000
19	0.925	1.668	0.213	2.704	0.555
20	0.000	0.000	0.000	0.000	0.000
21	1.082	1.942	0.210	3.131	0.557
22	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000
25	0.832	1.499	0.195	2.398	0.555
26	0.000	0.000	0.000	0.000	0.000
27	0.753	1.571	0.276	2.289	0.479
28	0.412	1.011	0.224	1.381	0.407
29	0.000	0.000	0.000	0.000	0.000
30	0.803	1.455	0.167	2.348	0.552
31	0.000	0.000	0.000	0.000	0.000
SUM	7.407	13.674	1.776	21.724	0.542
AVG	0.239	0.441	0.057	0.701	0.017

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.
NOTE:

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
AUXILIARY STORAGE PERFORMANCE

SITE: REEDY CREEK
REPORT PERIOD: MARCH,1979

SOLAR/2018-79/03

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	INCREASE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	*	*	*	*	*
2	0.273	0.000	0.125	72	1.000
3	0.000	0.000	0.007	72	1.000
4	0.000	0.000	0.000	72	1.000
5	0.155	0.000	0.019	73	1.000
6	0.011	0.000	-0.190	72	1.000
7	0.162	0.000	0.089	71	1.000
8	0.114	0.000	0.026	71	1.000
9	0.188	0.000	0.108	72	1.000
10	0.000	1.062	-1.282	67	1.207
11	0.000	0.000	-0.015	57	1.000
12	0.168	0.000	-0.042	57	1.000
13	0.532	0.000	0.430	59	1.000
14	0.552	0.676	-0.280	62	1.231
15	0.368	0.000	0.205	60	1.000
16	0.428	0.624	-0.366	60	1.273
17	0.000	0.000	0.037	57	1.000
18	0.000	0.000	0.026	57	1.000
19	0.522	0.925	-0.691	55	1.312
20	0.228	0.000	0.542	52	1.000
21	0.575	1.082	-0.598	54	1.085
22	0.301	0.000	0.640	52	1.000
23	0.234	0.000	0.269	58	1.000
24	0.000	0.000	0.078	60	1.000
25	0.000	0.832	-0.904	56	1.087
26	0.013	0.000	0.314	51	1.000
27	0.000	0.753	-0.767	51	1.019
28	0.000	0.412	0.071	46	-0.173
29	0.103	0.000	0.745	50	1.000
30	0.894	0.803	-0.019	55	1.137
31	0.000	0.000	0.041	54	1.000
SUM	6.015	7.407	-1.429	-	-
AVG	0.194	0.239	-0.046	60	1.005

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.